

REMARKS

Claims 1 – 5 and 7 – 21 remain pending in the application. Claims 4, 5, 10 – 12, 14, 19, and 20 have been cancelled. Claim 6 has been amended. The Applicants respectfully request reconsideration.

Claim Rejection Under 35 U.S.C. §112, First Paragraph

The Examiner states that the specification is replete with terms that are not clear, concise and exact, and that the specification should be revised in order to fully comply with the written description requirement of 35 U.S.C. §112, first paragraph. The Examiner provides several examples of language that the Examiner considers unclear. The Applicants respectfully disagree for at least the following reasons.

The Applicants are allowed to be their own lexicographers, and have used terminology in a consistent manner throughout the specification in a way that would clearly be understood by persons skilled in the art. In addition, the language used in the flowcharts shown in the drawings (FIGs. 7 – 10) and in claims is also consistent with the language used in the specification. For example, in the Background of the Invention, the Applicants describe what absolutely-defined frequencies are, i.e., those very precise frequencies that are defined by standards (e.g., ITU standards) for use in communicating signals over optical networks. In networks that abide by the standard, if signals are transmitted using these frequencies other than the absolutely-defined frequencies set by the standard, communications will break down.

In accordance with the invention, methods and apparatuses are provided that enable signals to be transmitted and received at frequencies that are not absolutely-defined frequencies, but are instead non-absolute frequencies. This obviates problems associated with having to use absolutely-defined frequencies that may drift over time due to the affects that temperature and aging can have on equipment, which result in a breakdown in communications over the network. Thus, a non-absolute frequency in accordance with the invention is a frequency that is other than an absolutely-defined frequency. A non-absolute frequency reference is a frequency that is selected to be

used as a reference with respect to all other non-absolute frequencies that will be used to transmit and receive signals over the network. (See specification at, for example, section [0016]).

Each node of the network has a tunable multi-channel device that is capable of transmitting and/or receiving signals over one or more channels, each of which uses a frequency that is different from the frequencies used by the other channels. The frequencies used by the channels of a given tunable multi-channel device are separated by a frequency difference that is stable and accurately defined and is the same for all of the other tunable multi-channel devices located at the other nodes of the network. (See specification at, for example, section [0023]). The frequency difference between channels is stable, accurately defined and is the same for the tunable multi-channel devices located at all of the nodes of the network. One of the tunable multi-channel devices at one of the nodes tunes one of its channels to the non-absolute frequency, which, as stated above, is a frequency that is not "absolutely defined". (See specification at, for example section [0023]). This is referred to in the specification as frequency aligning the channel to the non-absolute frequency reference. (See specification at, for example, section [0022]). Persons skilled in the art understand what is meant by frequency aligning a channel, or a laser of a channel, with a frequency. In the case where the node is a transmitter (it can be a transmitter and/or receiver node), a channel selector at the node is used to frequency align a transmitter laser to the non-absolute frequency reference. (See specification at, for example, section [0022]).

At that same node, the channel selector will set the other channels to transmit (or receive if it is receiver node) at frequencies that are separated by the aforementioned frequency difference so that the channels will not interfere with each other, and thus there will be no crosstalk between channels. This difference, which is also referred to as the channel spacing, is stable and accurately defined by the multi-channel device at the node. (See specification at, for example, section [0023]). Frequency alignment merely refers to the process of setting the channel frequency equal to the selected channel frequency as selected by the channel selector of the node. (See the specification at, for example, section [0024]). Different non-absolute reference frequencies may be transmitted to each of the nodes. (See specification at, for

example, section [0026]. All of the frequencies with which the respective channels are aligned other than the non-absolute reference frequency are separated by the channel spacing (i.e., frequency difference) to avoid reference and crosstalk.

The Applicants respectfully submit that the language referred to by the Examiner in claims 4 – 6, 10, 12, 14, 19, and 20 as being unclear or imprecise is the same language that is consistently used throughout the specification and drawings, and would, no doubt, be well understood by those skilled in the art. Furthermore, the Examiner's request that the specification be revised is not understood by the Applicants because the Applicants are allowed to be their own lexicographers, and the language in the specification is consistent with the claim language and is easily understood by those skilled in the art. Accordingly, the Applicants respectfully submit that the rejection is improper and request that it be withdrawn.

The Examiner has rejected claims 1 – 8 and 11 – 17 under 35 U.S.C. §112, first paragraph, as failing to comply with the enablement requirement. Specifically, the Examiner contends that claims 1, 11 and 13 recite "... having channels with mutually-identical frequency differences'. However, for any non-zero frequency differences, it is impossible to [sic] for channels to have 'mutually-identical frequency differences.' It is simply against the law of nature". The Applicants respectfully disagree.

The meaning of the claim language recited by the Examiner is well described in the specification. For example, in describing the illustrative embodiment of FIG. 1, the specification reads, on pages 8 and 9, sections [0029] and [0030]:

The tunable multi-channel device 7 is frequency alignable to the non-absolute frequency reference 8. Regardless of the tuning of the tunable multi-channel device 7, the frequency differences between the center frequencies of adjacent ones of its channels remains substantially constant. The frequency difference between the channels of the tunable multi-channel device 7 typically is equal to the desired channel spacing of the network 1. Alternatively, the frequency difference between the channels of the tunable multi-channel device 7 may be an integral fraction of the desired channel spacing.

Thus, it is clear from the specification that what is meant by a mutually-identical frequency difference is that the center frequencies of adjacent channels are separated in frequency by equal amounts.

For example, with reference to FIG. 3 and the corresponding description on pages 12 and 13 of the present application, a tunable multi-channel device 7 composed of an Fabry-Perot (F-P) etalon 39 is used to align the center frequency of the non-absolute frequency reference, which is 190,190 GHz, to the closest peak of the resonant frequency of the etalon, which is at 190,100 GHz. The control circuit 44 adjust the length of the etalon cavity to shift the center frequency of the non-absolute reference frequency by + 90 GHZ, which shifts all of the center frequencies of all of the other channels by + 90 GHZ. The frequency difference between adjacent channels is identical, and in this example, is 200 GHZ (See specification at, for example, section [0040], lines 5 – 6). This is clearly shown in FIG. 3, and would be clearly understood by a person skilled in the art.

In fact, the specification provides a “blueprint” for enabling a person skilled in the art to use existing components such as an F-P etalon to frequency align a center peak of one channel with the non-absolute frequency reference, which results in all of the other channels becoming frequency aligned with resonant peaks that are spaced apart from adjacent peaks by identical frequency differences. Accordingly, the Applicants respectfully submit that the specification is enabling, and respectfully request that the rejection be withdrawn.

Claim Rejection Under 35 U.S.C. §112, Second Paragraph

Claims 3 – 5, 10, 12, 14, and 19 have been rejected by the Examiner under the second paragraph of section 112. The Applicants respectfully traverse the rejection. The Applicants believe that the claim language is clear, precise and definite, but nevertheless have made certain amendments to make the meaning intended to be conveyed by the original language even clearer.

With the respect to claims 3 and 6, those claims have been cancelled.

With respect to claim 4, the phrase referred to by the Examiner “another of the channels” is intended to mean a channel other than the channel that is frequency aligned with the non-absolute frequency reference, which, in claim 1 is recited as “frequency aligning one of the channels of the tunable multi-channel device thereat with

the non-absolute frequency reference". Claim 4 has been amended to change "another of the channels" to "a channel other than said one of the channels". Claim 4 has also been amended to change "frequency aligning a receiver laser with the other" to "frequency aligning a receiver laser to said channel other than said one of the channels".

Other similar changes have been made by this amendment to claims 4, 5 10, 12, 14, and 19 to further clarify the claims. The changes to claims 4 and 5 are believed to be self explanatory and similar to the changes already described above with reference to FIG. 4. With reference to claim 10, this claim is directed to the embodiment described in the specification with reference to FIG. 6 in which a reference source comprises a plurality of reference lasers generates a plurality of respective non-absolute frequency reference signals that are frequency aligned to respective channels of a multi-channel device. These reference signals are broadcast to a plurality of nodes, each of which frequency aligns the frequencies of the optical signals that are transmitted and/or received by the node with respective non-absolute frequency reference signals. Claim 10 has amended to clarify that the generated non-absolute frequency reference signals that are broadcast to the nodes are signals that are frequency aligned with respective channels of the tunable multi-channel device. Claims 12, 14, 19, and 20 have been amended similarly to clarify the language with which the Examiner has taken issue.

The Applicants believe that these changes overcome this rejection for the reasons provided above, and respectfully request that the rejection be withdrawn.

Claim Rejection Under 35 U.S.C. §103

Claims 1 – 17 are rejected by the Examiner under 35 U.S.C. §103(a) as being unpatentable over Lida et al., U.S. Published Patent Application No. US 2002/0075539 (the '539 reference) in view of Vujkovic-Cvijin et al., U.S. Published Patent Application No. US 2003/0039015 (the '015 reference). The Applicants respectfully traverse the rejection.

The '539 reference is directed to wavelength division multiplexing and demultiplexing, and performs the multiplexing and demultiplexing functions in a way that

purportedly allows the number of channels to be increased without increasing intermodulation distortion that results when a large number of subcarriers are used to transmit and receive information. This reference is in no way related to the subject matter of the invention. The '539 reference discloses a wavelength division multiplexer (WDM) optical transmitter that converts electrical signals into optical signals and multiplexes them together for transmission over optical transmission mediums and a WDM optical receiver that demultiplexes the optical signals transmitted over the optical mediums to separate them and then converts them back into electrical signals.

There are several embodiments disclosed in the '539 reference, but in general, the WDM optical transmitter includes a band division portion that receives an incoming frequency multiplexed electrical signal and subdivides it into a plurality of frequency bands. The electrical signals of each of these frequency bands are then converted into optical signals, with a different wavelength being used for the optical signals corresponding to each frequency band. The optical signals are then multiplexed over the optical transmission medium.

On the receiver side, the optical signals received are separated out according to wavelength, and the wavelength-separated signals are converted into electrical signals. The electrical signals of the plurality of frequency bands are then reconstructed to obtain the plurality of frequency bands into which the original incoming frequency multiplexed electrical signal received at the WDM transmitter was divided by the WDM transmitter.

In accordance with an embodiment disclosed as invention 6 in the '539 reference, the WDM transmitter generates a reference signal that is converted by frequency conversion means, which shifts at least one of the electrical frequency bands up or down in frequency prior to converting the band into optical signals. The frequency band that is shifted is then converted into optical signals that have wavelengths that are different from any of the other optical wavelengths produced when the subdivided electrical frequency bands are converted into optical signals. The optical signals resulting from the shifted frequency band are multiplexed together with all of the other optical signals corresponding to the other frequency bands for transmission over the optical transmission medium.

On the receiver side, the WDM receiver comprises frequency conversion means that receives the electrical signals resulting from the conversion of the optical signals into electrical signals and shifts the electrical signals in frequency in a direction opposite to the shift in wavelength performed by the WDM transmitter. The shift in frequency of the electrical signals is based on the converted electrical reference frequency signal, as disclosed in inventions 13 and 14 of the '539 reference.

The Examiner cites section [0212] of the '539 reference as disclosing, "distributing a non-absolute frequency reference to nodes of the network". This is clearly is an incorrect interpretation of the '539 reference. The reference signal in the '539 referenced is multiplexed and demultiplexed along with all of the other signals, and is used to determine by how much the other electrical signals once converted from optical on the receiver side need to be shifted in frequency to be accurately reconstructed.

What is disclosed in the '539 reference has nothing to do with distributing or providing a non-absolute frequency reference to different nodes of the network that have tunable multi-channel devices that tune one of the channels thereof to the frequency reference in order to allow the nodes to communicate between themselves over the channel and/or over other channels that are tuned to frequencies that are separated from the frequency reference and from each other by known channel spacings (frequency differences), as recited in the claims of the present application. For example, claim 1 recites, in part, "distributing non-absolute references identical in frequency to nodes of a network" and "at each of the nodes, frequency aligning one of the channels of the tunable multi-channel device thereat with the non-absolute frequency reference".

The '539 reference does not disclose this feature of the invention or anything that can be construed as its equivalent. The reference frequency signal referred to in the '539 publication is a signal that has been frequency shifted and then multiplexed along with information signals that are at other frequencies for transmission in the optical domain. The signals are received and demultiplexed and separated out by frequency. The reference frequency is separated from the other frequencies, and all of the signals are converted from the optical domain into the electrical domain. The recovered

reference frequency signal is then used to frequency shift all of the other recovered electrical signals in the opposite direction of the original frequency shift to reconstruct the electrical signals. There is never a distribution of non-absolute references identical in frequency to nodes of a network and, at each of the nodes, frequency aligning one of the channels of a tunable multi-channel device with the non-absolute frequency reference, as recited in independent claim 1. The reference signal of the '539 reference is simply transmitted over a channel; it is never used to frequency align a channel. For example, when the demultiplexer receives and separates out the different frequencies, the recovered reference signal is not used to align the frequency of a channel, but, as stated above, is used to shift the other recovered signals to reconstruct the original electrical signals. All of the other independent claims of the present application include similar language with some variations. For at least these reasons, the rejection is improper and should be withdrawn.

The Examiner relies on the '015 reference as teaching the multi-channel devices generating channels with fixed channel spacings and a control circuit for frequency aligning one of the channels of the multi-channel device with the non-absolute frequency reference. The Examiner cites figures 2, 3 and 4. The '015 reference is directed to using absolute frequencies for each channel, which is exactly the opposite of the invention. The '015 reference is directed to tuning multiple lasers of a dense WDM (DWDM) system to an absolute frequency, and directing the light from the lasers into an etalon, which is then used to tune each of the lasers to a different etalon frequency fringe (resonant peak). The fringe that a laser is tuned to is the channel for that laser. The channels and the channel spacing are fixed and are referenced to the reference frequency. If one of the lasers fails, a controller elects an alternate laser that is then tuned to the channel of the failed laser and continues operations at the channel frequency.

It is abundantly clear that the '015 reference is directed to using absolute frequencies. Although the '015 reference discloses using tunable lasers that can be tuned to multiple wavelengths, there is never any suggestion of tuning any of the lasers to a non-absolute frequency. For example, section [0029] states:

An aspect of the invention uses a set of n lasers and k spare sources, wherein each laser is actively locked to a set of equally spaced wavelengths according to the ITU frequency grid, and simultaneously to a stable spectral reference wavelength. The set of equally spaced frequencies is generated by an etalon, acting as a frequency comb generator. The absolute wavelength standard is provided by a gas absorption cell. The wavelength of each channel can be changed on a millisecond (msec) time scale under microprocessor control in the event that any channel should fail, thereby enabling substantially instantaneous reconfigurability.

At section [0042], the '015 reference states:

Next, the reference frequency stabilized diode laser is frequency locked to a sequential fringe frequency of a (temperature) tunable stable Fabry-Perot etalon 112. The beam proceeds through to the etalon 112 which is tuned to a position where an etalon transmission fringe coincides with the laser wavelength locked to the reference spectral line derived from gas absorption cell 108. Passing through a lens 113 and into Detector 2 114, the transmission is monitored for tuning. The free-spectral range of the tunable etalon 112 is chosen to be equal to the required ITU grid spacing (e.g. 100 GHz for the current ITU standard), thus the etalon 112 transmission spectrum consists of a series of regularly spaced transmission peaks. Each of these transmission peaks will constitute a channel when fully initialize, tuned and configured.

At section [0051] the '015 reference states:

FIG. 4 is a graphical representation of a wave form illustrating the output produced by a multi-channel re-configurable transmitter. The transmission spectrum is shown as optical power 401 as a function of wavelength 408. The reference source wavelength 404 provides an anchor for a uniform spacing output grid, such as ITU grid 410. (ITU grid 410 is an etalon grid with a specific channel spacing.) For example, the grid 410 consists of frequencies with channel spacings 402 which comply with ITU standards.

At section [0062], the '015 reference states:

Replacing a laser that has failed without manual intervention by microprocessor/controller 530 which incorporates a look up table comprising operational parameters of all currently active lasers. When a failure is sensed, microprocessor/controller 530 elects an alternate laser, initializes the new laser to the failed channel specifications, attaches the failed laser's modulated signal to the new laser channel and continues operation within 20-50 milliseconds or less. This operation is seamless and transparent to a user due to the tolerances in communication protocol.

It is clear that everything described in the '015 reference is directed to using an absolute reference frequency and absolute frequencies that are spaced absolute distances from the absolute reference frequency at the etalon fringes, all of which are set in accordance with the ITU standard. Therefore, the combined teachings of the '539 and '015 references do not, in any way, teach or suggest the aspect of the invention of using a non-absolute frequency reference, as recited in the independent claims of the present application. Accordingly, for these additional reasons, the Applicants respectfully request that the rejection be withdrawn.

Furthermore, there is no suggestion for combining the teachings of the '539 and '015 patent because, if the Examiner construes the reference signal described in the '539 reference as a non-absolute frequency reference signal, then the '015 reference necessarily teaches away from the '539 reference because the '015 reference is directed to only using an absolute reference frequency. For this additional reason, the Applicants respectfully submit that the rejection is improper and request that it be withdrawn.

CONCLUSION

In view of the foregoing, the Applicants believe the remaining rejections have been overcome and/or traversed and that the application is now in condition for allowance. Should there be any further questions or concerns, the Examiner is urged to telephone the undersigned.

Respectfully submitted,
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